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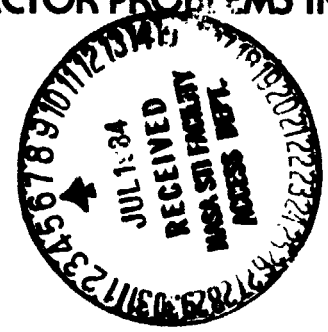

Captain William P. Monan

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ASRS
Aviation Safety Reporting System

NASA CONTRACTOR REPORT 166573

Cleared for the Visual Approach: Human Factor Problems in Air Carrier Operations

Captain William P. Monan
Battelle's Columbus Laboratories

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National Aeronautics and
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Ames Research Center
Moffett Field, California 94035

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ABBREVIATIONS AND ACRONYMS

AIM	Airman's Information Manual
ASRS	(NASA) Aviation Safety Reporting System
ATC	Air traffic control
ATIS	Automated terminal information service
DME	Distance measuring equipment (airborne)
FAR	Federal Aviation Regulations
IFR	Instrument flight rules
ILS	Instrument landing system navigation facility
MSAW	Minimum safe altitude warning
NASA	National Aeronautics and Space Administration
NON STAGE III	Not participating in Stage III service
STAGE III	Radar control and separation services in terminal area
TCA	Terminal control area
TRSA	Terminal radar service area
VFR	Visual flight rules
VMC	Visual meteorological conditions

CLEARED FOR THE VISUAL APPROACH: HUMAN FACTOR PROBLEMS IN AIR CARRIER OPERATION

by

Captain William Monan*

INTRODUCTION

> An aircraft may be cleared for a visual approach if the following conditions exist: Potential conflicts with all other aircraft have been resolved. Weather conditions at the airport are reported VFR. The pilot has reported sighting the airport. The aircraft is number one in the approach sequence or has reported the preceding aircraft in sight and has been instructed to follow it....
>
> ATC Handbook DOT 7110.65B, p. 75

The routine arrival of a scheduled air carrier flight into a major terminal area during good weather conditions triggers an ATC/airman communications dialogue that is as fixed in its phraseology as the airport's taped ATIS transmission or the waypoint entries in a "canned" flight plan.

The dialogue commences with these lines:

> XYZ controller: "Air Carrier ABC, report airport in sight."
>
> Air Carrier pilot: "XYZ Approach, Air Carrier ABC has the field in sight."

Every airline pilot in the country is familiar with the next instructions in the script.

> XYZ Approach Controller: "Air Carrier ABC, cleared for the visual approach to runway ___. Change over to tower frequency, one, one__point___."

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*Previously regional director of flight operations for an international airline, Captain Monan serves as an Aviation Safety Research Consultant to Battelle's Columbus Laboratories' ASRS Office.

There are only two one-step variations in the ritualistic interchange, both involving terminal traffic conditions. If the air carrier is being sequenced to follow another aircraft to the runway or, if another aircraft could potentially interfere with the air carrier's projected flight path to the field, then the flight crew must be advised and must report such traffic "in sight". Once this sighting has been affirmed, the ATC clearance terminology is amended to include "maintain visual separation from that aircraft, now cleared for the visual...." Since the pertinent traffic sighting may be solicited from either aircraft, an air carrier flight crew frequently may receive the reverse phraseology: "The other aircraft has you in sight and will maintain visual separation. You are cleared for the visual...."

A second possible insertion into the clearance dialogue may be a "maintain" restriction. A "maintain feet" usually indicates that a departure is tunneling through the arrival lanes or, less frequently, an enroute fly-by is passing at low level through the terminal area. A "maintain knots" airspeed restriction provides for spacing in the approach procession to the runway.

The visual approach shortcut to the procedural restraints of full-IFR operations represents significant time saving and workload reductions for both controllers and flight crews. The use of the visual approach unloads the radar controller's traffic separation responsibilities* and greatly expedites traffic movements. To the airman, the opportunity to make his own way to the runway is more than a convenience; in these days of soaring fuel costs, no flight crew is willing, in VMC conditions, to grind through a high overhead arrival routing, in a high drag configuration, to an 8 to 10 mile final.

This legal and desirable simplification of the IFR procedural complexity requires the establishment of appropriate safeguards. The formalized ritual of the controller/airman informational exchange provides them. Exactly as a challenge-and-response checklist functions in the cockpit, the ATC query-and-response formula "checks off" the necessary elements for safe accomplish-

*The "visual approaches are initiated by ATC to reduce pilot/controller workload and expedite traffic by shortening flight paths to the airport." AIM, C4-S8-13.

ment of the visual approach. The "airport in sight" and "traffic in sight" confirmations are as essential to air safety as the "gear down" and "three green lights" cockpit calls prior to landing. Satisfactory completion of this visual approach checklist -- by a controller's strict adherence to his prescribed role as challenger and by an airman's accurate and unequivocal responses -- would appear to ensure adequate shielding of an air carrier's VMC descent from approach altitude to its landing.

Yet numerous reports to NASA's Aviation Safety Reporting System (ASRS), both from controllers and pilots, narrate a series of serious hazardous occurrences associated with air carrier conduct of visual approaches. In-flight traffic conflicts frequently were mentioned but the "what-went-wrong" event list included such incidents as grossly unstabilized approaches, line-ups or landings on the wrong runways, or, at times, on the wrong airports, go-arounds, and the contrary "We made it in but we should have gone around." admissions, landings without tower clearances and a plethora of varied deviations from ATC instructions or clearance.

There is no doubt that the visual approach is an essential tool for coping efficiently with congested terminal airspace conditions and for enhancing airline operating economy. It must continue in use. The purpose of this research study was to identify and examine the obvious operational hazards and the perhaps not-so-obvious human factor pitfalls reportedly encountered in execution of the visual approach procedure. The analysis of the causal factors for such anomalies could produce suggestions or recommendations for operational practices that might assist in averting future mishaps.

APPROACH

All air carrier reports submitted to the ASRS during a continuous 33-month period (covering incidents reported as occurring between May '78 and January '81 inclusive) were examined for association with the visual approach procedure. Four hundred fifty-two such reports were retrieved from the ASRS incident database. Preliminary analysis of this document set revealed that 99 were either multiple reports of single events or incidents without signi-

ficant relationship to the visual approaches mentioned in the narratives. The remaining 353 occurrences displayed meaningful associations with the visual approach procedure, either during the vectors-for-visual phase or during the final approach segment conducted under tower control.

Two broad questions were posed as research guidelines for analysis of the document set: (1) what went wrong during the visual approach? and (2) what were the primary and associated causal factors for the events?

RESULTS

Table 1 presents the results of the analysis of the study dataset. The primary and secondary causal factors discovered to be present are in the left column subdivided into "predisposing conditions" that appeared to have set the stage for commission of a variety of "human performance errors". The hazardous events resulting from these errors are tabulated as seven categories of "outcomes". In several of the 353 reported occurrences there were multiple outcomes so the "all causes as combined" total is 375. In nearly all of the occurrences a multiplicity of causal factors was observed and these are separately itemized for purposes of analysis.

DISCUSSION

The primary causal agent for the seven categories of hazardous events represented some form of human error. However, the human factors seldom could be isolated from the narratives as single, uncomplicated cause-and-effect sequences. Rather, the errant airmen or controller actions, of omission or commission, were webbed with interactive multiple and diverse circumstances and/or variable physical and environmental conditions. These enveloping factors induced, or contributed to, or comingled with the human limitation factors in forming the event chains. So comingled were the circumstantial elements that many reporters, uncharacteristically in ASRS report data, frequently appeared to be unaware of their own nonconformities with procedural steps and tended to allocate blame for the hazardous developments to deficiencies in the visual approach procedure.

TABLE 1. CAUSES AND HAZARDOUS OUTCOMES ASSOCIATED WITH AIR CARRIER VISUAL APPROACHES

CAUSES	OUTCOMES							
Predisposing Conditions • Human performance errors	Conflicts	Unstabilized Approaches	Altitude Deviations	Landings Without Tower Clearance	Approaches or Landings on Wrong Runway	Approaches or Landings on Wrong Airport	Descent Toward Terrain, Obstructions, Etc.	TOTAL
All Causes as Combined	244	25	35	31	25	9	6	375
Inadequate Accomplishment of Procedural Steps Related to Sighting								
• Airport sighting errors	6	-	-	-	-	9	6	21
• Traffic sighting errors	68	-	-	-	-	-	-	68
Parallel Runway Operations								
• Overshoot/drift into adjoining lane	20	-	-	-	-	-	-	20
• Crisscrossing through adjacent lane	19	-	-	-	-	-	-	19
• Lineup in wrong lane	13	-	-	-	26	-	-	39
• Controller or pilot random errors	11	7	-	8	-	-	-	26
Presence of Uncontrolled VFR Aircraft								
• Traffic sighting deficiencies	61	-	-	-	-	-	-	61
Reduced Cockpit Visibility Conditions								
• Visual perception deficiencies	23	-	3	1	4	-	1	32
Traffic Mix - Airspeed Performance Differential								
• Parallel runway related errors	14	-	-	-	-	-	-	14
• ATC spacing misjudgements	12	-	-	-	-	-	-	12
• Flight crew traffic sighting errors	14	-	-	-	-	-	-	14
• Flight crew technique errors	6	-	-	-	-	-	-	6
• Flight crew spacing errors	5	-	-	-	-	-	-	5
Traffic Mix - Simultaneous Departures and Arrivals								
• ATC coordination errors/misjudgements	19	-	-	-	-	-	-	19
• Pilot encroachment of approach lane	13	-	-	-	-	-	-	13
• Altitude deviations	5	-	-	-	-	-	-	5
• Errors related to intersecting runway operations								
• Opposite direction traffic same runway								
Communications Misunderstandings and Errors								
• Expectation errors	-	-	17	-	-	-	-	17
• Transposition & other misc. errors	-	-	-	12	-	-	-	12
Workload Distractions								
• Various errors	-	-	14	18	-	-	-	32
Hasty Misjudgements								
• Flying technique errors	4	25	4	7	2	-	-	42

In the following discussion, causal factors are considered in their observed groupings as related to the conduct of visual approaches.

INADEQUATE ACCOMPLISHMENT OF PROCEDURAL STEPS IN AIRPORT/TRAFFIC SIGHTING EXCHANGES

The protective framework of the visual approach procedure consists of two queries by the approach controller: "Do you see the airport?" and/or "Do you see your traffic?" Upon the flight crew's affirmative responses to these two sighting requirements, the rigid system controls of full IFR operation are relaxed. The release of the aircraft to tower frequency automatically stops radar surveillance services and the air carrier pilots are free to make their own way to the landing runway.

Airport Sighting

The airport sighting query was seldom omitted from the dialogue. Only 3 airman reports noted absence or apparent disregard of a negative response. Typical quotations from these reports are:

> "Approach control asked if we had the airport in sight. Our reply was 'negative!' The controller then said, 'Okay, cleared visual approach.'"
>
> * * * *
>
> "On two occasions a controller has assumed that we had the airport in sight and cleared us for the visual approach."

However, while airmen rarely reported the absence of the airport sighting challenge, they often protested controller pressures in eliciting hasty and -- what appeared to them -- premature "airport in sight" responses from the cockpit. Since the responses usually triggered an immediate "cleared for the visual--change over to tower" insertion into see-and-avoid responsibilities, pilot reports on being pushed into the visual approach regime reflected unease and umbrage.

"We were downwind, being given a hurry-up visual. 'Have you got the field in sight yet? Not yet? You're number one....' that kind of deal."

In two submissions, provoked airmen reported that, after they had denied that the airport was in sight, controllers had resorted to requesting visibility conditions from other aircraft.

Controller reports, however, provided insight for understanding their "not yet?" promptings of the flight crews for affirmative airport sighting responses. Rush hour streams of inbound arrivals -- reported as high as 20 or more aircraft -- placed great pressure upon approach controllers to induce the lead aircraft into early acceptance of the visual approach.

"Inbound traffic was heavy -- it was backed up in all directions. I was anxious to get the number one aircraft down as soon as possible...I cleared ABC for the visual approach....However, numerous data blocks apparently overlapped each other and hid a target...."

Cockpit deficiencies in airport sightings resulted in three types of hazardous events. One set of six apparent missightings involved conflicts with other aircraft. A second group of nine incidents involved approaches or landings at the wrong airport. A third category consisted of six air carrier descents below safe altitudes toward high obstructions or into prohibited areas.

Traffic conflicts. - Since the six traffic conflicts incidents did not appear to have a logical cause-and-effect correlation with an airman's non-sighting of the airport, they were carefully scrutinized. The air carrier near-encounters with other aircraft reported by ATC controllers were often coupled with controller observations of the air carrier's erratic flight path into lineup on the extended centerline of the landing runway. "Apparently the pilot never saw the runway because he overshot his turn...." "Apparently, he never saw the runway because he passed through the ILS course...", etc. The zig-zag heading deviations led to controller conclusions that the airport sighting must not have been made.

Comparison of the controller and airman report narratives suggested a fundamental ambiguity in the "airport in sight" procedural response. All controller reports specifically emphasized "runway" while all airmen reports utilized the "airport" terminology. It appears from the contexts that, to controllers, airport sighting signifies runway sighting and, furthermore, carries a full expectation that the aircraft would track the shortest, most direct course into lineup in the approach lane. Contrariwise, airmen seem not to apprehend that their airport sighting call precludes any subsequent runway reorientations or flight path realignments to the assigned runway. This airport/runway ambiguity seemed especially significant during operations involving parallel runway layouts.

This inferred difference in understanding was supported by one facility supervisor's specific comment: "We take airport sighting to mean that the pilot has the runway made." (Underlining added)

Approaches or landings at wrong airport. - The second set of nine inadequate airport sightings consisted of low final approaches to, or landings at, the wrong airport. The airmen's narratives of these events were remarkably similar: brief, factual recountings of prosaic cockpit functions during a routine arrival proceeding until an O. Henry-styled, unexpected and abruptly shocking conclusion.

> "After normal landing, the tower called to ask for our position. At that time we realized...."
>
> * * * *
>
> "A normal landing was made but during turn around on the runway our nosewheel sunk into the pavement. At this point the flight crew realized...."
>
> * * * *
>
> "While starting a left turn into the runway, checklist was completed. Then I again reestablished visual reference with the runway and made the final approach and landing. As we began to taxi, we realized...."
>
> * * * *

"The Captain said, 'That's it!' so I configured the aircraft for landing. At about 500 feet, the runway looked too short. I said, 'This can't be it!' The Captain said nothing. As I started climbout, the tower called and advised that the safe altitude at where we were located was 2300 feet."

All the wrong-airport reports were characterized by a perfunctory assumption in the cockpit that the airport in sight must be the destination field. For reasons not stated in the narratives, the flight crews "did not bother" with crosschecks of navigational instruments. "This would not have happened if we had used all the Navaids", stated one airman. "Before our DME locked on, the airport was sighted and descent made into the traffic pattern", explained another pilot. "We were reluctant to request vectors in locating the field because this would have possibly used up more time and fuel", reported an apologetic First Officer.

Descents below safe altitude, toward obstructions or prohibited areas. - Another cluster of six apparent airport sighting deficiencies was submitted by controllers who had radar-observed air carrier descents toward high obstructions or into prohibited areas. In a reversal of the controller "push into the visual", several of these reports indicated that it was the airmen who opted for early release from IFR altitude restrictions. In these incidents, the "airport in sight" transmissions were volunteered at considerable distance out from the field, followed by a too-early descent that distorted the normal altitude versus miles-to-go relationship.

"About 20 miles out, the air carrier reported airport in sight and I cleared the aircraft for a visual. Then I got busy with several other aircraft. I did not notice the rapid descent of the air carrier until the MSAW alert sounded. His altitude readout indicated going through 5000 feet. I issued an immediate low altitude alert -- 'high terrain at 12 o'clock, 3 miles, at 4700 feet'. The aircraft climbed immediately. Later the tower told me that the flight crew asked him for the meaning of 'low altitude alert'."

* * * *

"The pilot reported 'airport in sight' and requested a visual approach. The approach controller issued the

visual clearance and changed the aircraft to tower frequency. However, the jet did not call the tower. He was observed descending and turning southward toward the ABC radio station antennae (1311 feet MSL). When the aircraft reached 1700 feet and 1 1/2 miles north of the antennae the low altitude alert alarmed. He continued to descend to 1400 feet and his radar target touched the radar markings of the antennae. He then climbed up to 3000 feet and called the tower."

Traffic Sighting

The airport sighting deficiency patterns were paralleled with respect to the second step in the procedural dialogue -- the query and response of the sighting of pertinent traffic. Both controllers and airmen committed traffic sighting procedural errors -- there were 68 such occurrences in the study data set. As indicated in Table 1, all led to a single type of outcome: traffic conflicts of varying degrees of criticality.

Airmen reports of a controller's apparent disregard of a cockpit "negative" response to a point-out of traffic were minimal (5 reports) and mildly remonstrative.

> "The controller asked if we had the light aircraft in sight. We advised 'No'. He then cleared us for a visual approach to follow the small aircraft. How can they do this? Follow an aircraft we do not see?"

Perhaps more significant, due to their ATC sources, were two controller submissions noting that the shrug-off of nonsighted aircraft was "a common occurrence" at their facilities.

> "The pilot stated that he had never seen the aircraft that he was supposed to be following and still had been cleared for the visual. The incident is a common occurrence at this airport. It is poor traffic control."

Far more numerous and more troublesome as operational deficiencies were airmen inadequacies in traffic sighting responsibilities; four separate problem areas were identified:

- Sighting of called traffic apparently not accomplished
- Apparent loss of initial sighting
- Apparent nonsighting of air carrier by traffic that "has you in sight"
- Identifying the wrong traffic as the called target.

In addition, an ATC procedure reported at certain terminal areas appeared to contribute what was, in effect, a fifth category of flight crew nonsighting of critical traffic -- an incomplete exchange of sighting information.

Airmen nonsighting of called traffic. - Controller impressions that airmen never had sighted their traffic were derived from observations of conflicts with traffic that had been acknowledged as "in sight" by the flight crews.

> "I pointed out the traffic to the air carrier and the pilot stated he had the traffic. I then cleared him for the visual to runway ___. Evidently the air carrier did not have the traffic because while on final he came back on the frequency and stated, 'We almost hit one broadside!'"

Numerous airmen reports testified to initial sighting omissions. Twenty flight crew submissions simply noted that traffic had been pointed out to them and, subsequently, a conflict with that traffic had taken place.

> "Traffic was called at 2 o'clock, the First Officer acknowledged and switched over to tower. As we made our turn, a light twin appeared, close, and on collision course...."

These types of "Roger" acknowledgements of traffic pointouts were puzzling in that the reports did not reflect any expressed sense of urgency or even high priority in sighting the called traffic. There appeared to be a broad pilot assumption that other aircraft were not and would not become pertinent factors in their visual approaches. The surprise encounters were more acute when aircraft crisscrossed through the final approach lane. "ATC had told us of traffic on both sides but we did not expect crossing traffic, especially at low altitude...."

Flight crew loss of initial traffic sighting. - A similar apparent false sense of security (13 reports) surfaced in air carrier conflicts that could be attributed directly to flight crew loss of initial sighting. In this ominous situation -- directly reminiscent of the tragic midair collision at San Diego in 1978 -- none of the airmen had reported the loss of sighting of traffic to the ATC controllers.

The lost sighting intervals effectively doubled the exposure to midair collision risk during conduct of the visual approach. Not only was the position and course of the traffic unknown to the flight crew but the airmens' prior reports that they had sighted their traffic could dissuade controllers from intervening in a merging target situation being observed on the radar scope. Four controller reports expressed alarm and extreme frustration after witnessing convergence of two aircraft during which a second controller, controlling the approaches, refused to communicate the closing situation to the airmen. "It's okay, he's got him in sight" was one intrafacility reassurance. "Don't worry, he's VFR!" comprised another refusal to intervene. A concerned airman stated, after his near collision incident, "I was told that the approach controller noticed the two aircraft merging on his scope but issued no warning".

The double hazard in lost sightings unreported to ATC was clearly defined in this controller's protest:

> "We have a very lax attitude toward visual approaches at this facility. Even when traffic has been issued and acknowledged, if it is still closing, some further control action should be taken!"

Apparent nonsighting by other aircraft. - One set of air carrier incident (17 reports) reflected use of the reverse ATC clearance phraseology, "the other aircraft has you in sight and will maintain visual separation from you." The reporters in these "the other aircraft has you..." types of incidents could only speculate as to the probable causes for the conflict occurrences. "The other pilot said he saw the air carrier but apparently did not...", "The other aircraft must have lost sight of his traffic...", "It

appears that the twin aircraft initially had us in sight but then must have lost us...", etc.

Airmen misidentification of called traffic. - Another set of incidents (14 reports) involved flight crew identification of the wrong aircraft as their called traffic. The conflict patterns in the 'misidentification of called traffic' events were not only similar but almost identical in their operational sequences: the ATC instructions "to follow that aircraft" in the approach, the traffic in sight and well ahead, and then the abrupt realization that the other aircraft, unseen, with position unknown, was somewhere above, below, or behind the air carrier.

> "About the time I saw the airliner that we were following touch down on the runway, I heard the tower say, 'Air Carrier ABC, cleared to land'. At this point I realized that the aircraft we had been following was not air carrier ABC. I said to my First Officer, 'Where is he?' The F/O looked down to the right and said, 'There he is, beneath us!'"

Various reports of target misidentification were related to inadequate descriptions of traffic by the ATC controllers.

> "The controller advised that we were to follow a company aircraft on final. Both the F/O and I saw an aircraft that looked like it had a company paint scheme. I reported that we had the traffic in sight. We were turning into final when...."

The narratives included such phrases as the following: "It is impossible to recognize any specific aircraft type against a late afternoon sun...", "We can't identify an aircraft by its company markings...", and "ATC should use an o'clock direction and a distance away as well as the aircraft type."

Incomplete sighting exchange. - While human procedural errors dominated the traffic sighting failure categories, one reported ATC practice -- apparently standard -- appeared to cancel out a major element of the protection designed into the visual approach procedure. This was the routine query of traffic sighting from an aircraft on base leg that subsequently was turned on to final in front of a second aircraft on straight-in approach to an

adjoining runway. The flight crew in this second aircraft was not routinely queried as to their sighting of the aircraft being positioned in front of them. The hazards in this facility practice developed directly from parallel runway operations. A highspeed overshoot into the adjoining lane, an imprecise, wobbly lineup due to glare, setting sun position or haze, a cockpit misunderstanding of the L/R runway assignment -- any of these errors could precipitate a crisscrossing or overtaking conflict situation stripped of the protective elements built into the sighting exchange. Several controllers recognized the trap in mismatching the traffic query with aircraft sequencing. "In such cases," noted one reporter, "both aircraft should be required to sight their traffic". A more terse comment read, "This practice does not conform with FAR requirements for sighting traffic."

ERRORS IN THE CONDUCT OF PARALLEL RUNWAY OPERATIONS

Eighty visual approaches -- 23 percent of the study dataset -- culminated in hazardous outcomes resulting from errors induced by, or exacerbated in the presence of, parallel runway operations. In some, air carriers on visual conflicted with other aircraft; in others they attempted unstabilized approaches, landed on the wrong runway, or landed without tower clearance.

As indicated in Table 1, there were 63 traffic conflicts associated with visual approaches to parallel runways; these were caused by four categories of error that were identified as the primary causal factors for the incidents. The latter two factors were also associated with other hazardous outcomes; approaches or landings on wrong runways, unstabilized approaches, and landings without clearance.

Overshoots or Drifts Into Adjoining Lane

There were 20 reports of lane overshoots or drifts (14 by air carriers, 6 by other types of aircraft). In these conflict incidents, the airmen narratives permitted identification of two secondary causal factors that induced

or contributed significantly to the overshoots: (1) ATC vectoring that placed the air carrier on a high-angled intercept turn into the ILS and (2) reduced cockpit visibility conditions from glare, a setting sun, or haze.

> "We were much too high, too close and at a 70 degree angle to the runway. Nevertheless, we were cleared for the visual approach. Dumping everything and with full flaps down we still could not avoid overshooting the final into the path of another aircraft on approach to the parallel runway. We made a missed approach...."

Crisscrossing Through Adjacent Lane

The majority of the 19 incidents in the crisscrossing category of events appeared to result from routine ATC runway assignment practices in use at numerous terminals. At some airports, light plane arrivals were channeled into short runways, frequently necessitating low altitude traversal of the approach courses being used by the jets. At other fields, the inbound flow was split into X-shaped patterns by runway length, structural load capabilities, or local noise-abatement policies. At times, a runway switch was offered as a "pilot convenience" for reduction of taxi distance into company gates.

The crisscrossing conflicts during parallel runway operations were characterized by cockpit inadequacies in sighting the converging traffic. Some narratives were tinged with complacency in airman attitudes, "We assumed that the traffic would not be close to us...", and in controller actions, "We were given clearance for the visual with immediate change over to tower frequency even though we said that we were unable to spot the traffic that would be crossing in front of us".

Overall, the air carrier airmen were opposed to the crisscrossing practices. "San Diego is waiting to happen again", protested one airmen, "and this (crisscrossing) may well be the cause."

Lineup in the Wrong Lane

Conflicts. - The 13 reported lineups in the approach lane to the wrong parallel runway primarily reflected errors by pilots in aircraft other than

the air carriers. Three flight crew misalignments appeared to denote faulty cockpit management techniques induced by over-familiarity and over-exposure to routine. "We were conditioned to use the runway closest to our terminal", explained one pilot. "Since only one runway was in sight we did not bother to reference our flight instruments", read another report. The third submission stated, "The First Officer, who was flying, thought the Captain had changed over the ILS frequency to the other (parallel) runway...."

All other instances of lineups in the wrong lane developed into overtaking sequences that were symptomatic of a broader, more significant factor in visual approach occurrences: this was the operational mix of slow/fast, prop/jet equipment in terminal airspace. "Small aircraft are like bicycles on the freeway", read an air carrier pilot's simile, "they don't belong in congested airspace."

Approaches or landings on wrong runway. - A total of 26 lineups in the wrong parallel approach lane were reported. Several of the completed landings -- on the wrong runway -- appeared to have placed the aircraft in serious jeopardy: they were made on closed runways with obstructions that severely limited the distances available for stopping the aircraft. "This was an unnerving experience", was one airman's comment.

The cockpit circumstances that contributed to the wrong lane confusions were familiar details in air carrier operations: rushed landing preparations that diverted flight crew attention from controller transmissions, selection of the wrong ILS frequency, misunderstandings of the L/R runway assignments and "habit conditioning" in using "the other runway".

Controller or Pilot Random Errors

Conflicts. - The random errors by ATC controllers or by airmen consisted of 11 missteps or slip-ups associated with the parallel runway operations. These reports included such actions as quick, impulsive, unauthorized turns into the adjacent and occupied lane, ATC vectoring of two aircraft at the same altitude to the same outer marker and assignment of the same runway to two air carriers conducting simultaneous visual approaches.

"The clearance given to the wide body was also to 16R but the controller's slip of the tongue simply did not register with us. Therefore, I was not concerned with the tower controller's advisory of the widebody at 9 o'clock and 4 miles, then 8 o'clock 2 miles, then 7:30 and 3/4 miles. At approximately 550 feet, as we were making a shallow angled bank into the runway, I was startled by the sudden appearance of a white light and loud noise to my left. I glanced left and down and there was the wide body passing beneath us, by approximately 100 feet. I applied max power...."

Unstabilized approaches. - Parallel runway operations were involved with seven unstabilized approaches. If the runway thresholds were greatly staggered, late controller switches in landing runway assignments translated immediately into high, fast, above-the-glide-slope approaches.

Landings without tower clearance. - "We were concentrating on the traffic abeam of us...", "Our attention was focused on maintaining separation from traffic in the adjoining lane...." Such were the airmen explanations that tied-in parallel runway operations with eight landings accomplished without tower clearances.

PRESENCE OF UNCONTROLLED VFR AIRCRAFT

The "roger" acceptance of the ATC Controller's "cleared for the visual" message commits the flight crew for sole responsibility for traffic avoidance with two separate categories of VFR traffic. The pilots not only assume responsibilities for known aircraft -- those targets previously pointed out to them before radar surveillance was withdrawn -- but must also self-avoid those VFR aircraft whose primary target has not been detected by approach control radar. Although the acceptance of a visual approach by an IFR aircraft in no way "creates" this untargeted VFR traffic -- presumably it would be there needing to be avoided regardless of the type of approach clearance the IFR traffic has -- it nonetheless follows that needing to deal with untargeted VFR traffic is an innerent and unavoidable feature of flying a visual approach because of two factors: first, (by definition) as visual conditions must exist, uncontrolled VFR aircraft must be expected to be shar-

ing the airspace with IFR traffic; and second, when the visual approach is accepted by the flight crew, even the potential "workload permitting" assistance of ATC is inexorably withdrawn with the (usually) immediate termination of radar services.

A quarter (61 incidents) of all air carrier conflicts identified in the visual approach study consisted of air carrier convergences in the approach area with uncontrolled VFR traffic. Of these, thirty-nine percent (24 incidents) were with unknowns.

Lack of transponder equipment appeared to be an active causal agent for controller failure to call out such aircraft. "The radar approach controller apparently did not see this target...." Approach was queried. "'No', they said, they had not seen the target nor a beacon". "I didn't observe nor issue this traffic...", etc.

Additionally, in the instances when the uncontrolled VFR targets could be issued to the air carrier, the "altitude unknown" phrase in the call outs made the advisories into cockpit sighting imperatives. The traffic could be thousands of feet above or below the air carrier but also, it could be at the identical altitude.

The hazard risk in these types of encounters appeared to be high: the majority of incidents were characterized by late sightings of the traffic and by close, narrow-miss distances. "We missed by about 150 feet...", "... 100 to 150 feet...", "... a 50 foot miss...", "...by about 25 feet".

The reports indicated that both the riskiness and the numbers of convergences varied sharply in relationship to types of ATC terminal airspace configurations. Fifty-three reports of the air carrier/uncontrolled VFR aircraft conflicts took place in TRSA or NON STAGE III operations. Seventeen reports could be specifically associated with nearby general aviation airport locations. TCA occurrences were few (8 reports). Furthermore, the within-the-TCA conflict happenings were noncritical: the uncontrolled intruders were radar observed, timely advisories were issued and the air carriers side-stepped around the aircraft and continued on their visual approaches. The majority of the TRSA and NON STAGE III events were more critical.

"I spotted a strobe light at 12:30, close. I pulled speed brakes, pushed the nose down and we passed under the aircraft by 100 to 150 feet. Approach control said they had no one on their radar in our vicinity."

* * * *

"While turning on a 5 mile final we passed about 150 feet directly above a brown and yellow aircraft...."

* * * *

"The controller called 'traffic, 12 o'clock, less than a mile'. I looked out, saw nothing. The first officer made a quick, sharp pull at which time I saw an aircraft pass beneath us."

Inasmuch as the air carriers, by acceptance of the visual approach clearance, and the uncontrolled VFR aircraft, by pilot personal choice, were operating under see-and-avoid principles, the set of 61 conflict occurrences was closely examined for traffic sighting inadequacies, deficiencies, or failures.

Fifteen of the narratives indicated that flight crew sightings of the closing VFR aircraft had been early enough to avoid by miss distances termed as "too close for comfort" and similar subjective measurements. In 39 convergences, the air carrier apparently was in more serious jeopardy. Sightings of the traffic were late and miss distances were minimum. A selection of airman phrases illustrates the abrupt sightings, the close proximity of the "unknown" on collision course and the need for hard, quick evasive maneuvers:

"Suddenly the Second Officer pointed and the First Officer took the wheel from me and steepened the bank angle...."

* * * *

"'I've got him!' said the First Officer and he made a quick, sharp pull as a small aircraft passed under our nose."

* * * *

"I pulled up and went over the top of the small aircraft. The miss distance was estimated at 25 feet plus or minus ten feet."

In 7 near misses, the see-and-avoid concept apparently failed completely. No evasive maneuvers were taken by pilots in either aircraft and the flight crew sightings were reported as "too late to take evasive actions".

"All three of us saw the other aircraft but not soon enough to take any action. He passed over the top of us, very close...."

* * * *

"It happened so fast that no evasive action was possible. He passed about 200 to 300 feet behind us."

* * * *

"Just after we switched over to tower frequency, the controller called traffic. As we completed our turn we saw the traffic passing about 100 feet beneath us. No time for any evasive action."

* * * *

"We were advised of unidentified traffic SE bound but we could not sight it. We had started our turn on to base when we saw a light twin at our altitude.... No evasive action was taken as it was too late and the aircraft was gone."

The most repetitious and, perhaps, most significant comments narrated in the uncontrolled VFR aircraft/air carrier conflict reports were the air carrier airmen's observations on the apparent sighting failures of the light plane pilots. "The small aircraft made no move to avoid us." "I don't think the other pilot saw us since he took no evasive action." "The twin never changed profile, left or right, up or down...." "There was no apparent evasive action...." "There was no evidence of...", etc., etc. Only three of the 61 narratives indicated that the uncontrolled VFR aircraft already had initiated evasive action prior to flight crew sighting. Several other reports noted simultaneous sightings with near-simultaneous evasive maneuverings.

However, the reports only reflected the perceptions of the reporting air carrier pilots. The ASRS program appears to receive proportionately fewer reports from GA pilots than from air carrier flight crews; in the case of this study, the small number of GA submissions precluded any cross-comparisons with the jet airmen's observations.

Thirty-seven of the 61 reports specifically mentioned traffic call-outs by an ATC controller. In several of these incidents, the airmen gave credit to the pointouts for preventing imminent midair collisions.

> "The air carrier had been cleared for a visual into ABC airport. I issued him traffic, one o'clock, and the pilot reported 'in sight'. Since there were two targets (at 1 o'clock and at 11 o'clock) I wanted to make sure the pilot had sighted both aircraft so I told him again 'Traffic 11 o'clock'. The pilot then said if I had not called traffic he would have hit him.... He thanked me and said, 'that was awful close!'"

* * * *

> "The controller said again, 'traffic now 12 o'clock, 2 miles'. We saw an air carrier above us and called him out. The controller responded, 'No, he's an IFR. Your traffic is 12 o'clock'. Then I saw a gray outline heading toward us in the settling darkness, 1 mile or less. I put approximately 2 G's on the aircraft in zooming up over the small aircraft.
>
> "I would like to stress that if it had not been for the controller's diligence in repeating the traffic call we would possibly not have sighted the conflicting traffic in time."

The controller radar advisories did not always eliminate cockpit difficulties in picking up head-on or tail-on targets. "Even in clear skies, with the entire crew looking, traffic on a tail-on closure was difficult to detect". Four other incidents, all similar in pattern, represented a familiar sighting trap: flight crew attention drawn to the 12 o'clock sector by radar advisory while a second aircraft, not targeted, converged from a different direction.

> "Another traffic advisory had drawn our attention toward 1 o'clock when a small aircraft passed very close over us from the 9 o'clock position."

* * * *

"As a result of a 12 o'clock traffic advisory, 3 miles, both pilots were straining to look out the forward windshield panels. Apparently this aircraft must have been at our 9 o'clock position...."

REDUCED COCKPIT VISIBILITY CONDITIONS

Every seasoned air carrier pilot has been through this experience: "sky clear, visibility more than one five" and cleared for the visual approach. A routine operation until the final turn to the field rounds out on a heading straight into a blinding sun low on the horizon.

"As we came through a heading of about 160 degrees we encountered a reflecting glare of a haze level that completely eliminated cockpit visibility.

"We lost visual contact with the field, the localizer was overshot and we passed in close proximity in front of another air carrier on approach to the parallel runway."

Haze, smoke, smog and glare from a rising or setting sun are familiar, real-life environmental conditions in airline operations: flight crew reports that referenced reduced cockpit visibility were matter-of-fact acceptances of this reality. "Haze made traffic observation difficult which is why all 3 of us were looking outside and not at our altimeters." "Our traffic was pointed out to us but we could not spot him due to the haze...." "The weather was clear but the sun in the west greatly reduced visibility...." One airman submitted a plea for empathy:

"If local controllers could ride through some of these approaches (in the early evening, landing into the sun), they could visualize our cockpit problems more clearly."

The "cockpit problems" referenced in the above narrative were the subject of 32 reports of hazardous incidents during visual approaches. They consisted of imprecise lineups on the extended centerline of the runway, inability to sight called traffic, distraction from altitude awareness and misidentifications of the assigned parallel runway for landing.

The temporarily impaired cockpit visibility conditions contributed to 23 air carrier conflicts with other aircraft. Of the 23 co-participants 17 were light aircraft, some of which were operating as uncontrolled VFR activities (5 reports). A sample of airmen comments is displayed below:

> "The aircraft was very close before we sighted it, he was headed almost straight at us... we immediately turned and pushed the nose down and he passed over us."
>
> * * * *
>
> "The collision danger of jets and small aircraft using the same terminal airspace is greatly increased by the reduced visibility around our major cities."

The operational mix of light aircraft with the faster jets developed into several overtaking events while parallel runway operations served as secondary causal factors for both conflict incidents and approaches to the wrong runway.

TRAFFIC MIX -- AIRSPEED PERFORMANCE DIFFERENTIAL

Forty-six overtaking sequences were identified in the traffic conflict events -- 19 percent of all conflict occurrences in the study. The majority of the overtakings (40 reports) reflected an operational mix of aircraft with airspeed performance differentials. The remaining incidents (6 reports) apparently stemmed from airmen's failure to adhere to "keep your speed up" instructions, from too-early transitions into landing configurations and "Let's beat the other guy in" demonstrations of competitive zeal.

The mismatch of slow/fast, prop/jet, single/multiple engine equipment exists only as a latent hazard circumstance in terminal airspace until activated as a causal agent for conflict through some form of pilot or controller misjudgement, misperception, or injudicious action. An ATC "squeeze in" of a light plane into the approach sequence, an airman's failure to "keep it in close", a flight crew's misidentification of traffic to follow -- such were typical links into overtaking sequences.

"This insertion of light planes (into the approach sequence) might work out if there were closer coordination between approach control and the tower. Often it seems that one doesn't know what the other is doing.

"The result: the air carrier pilot is in for a surprise when he switches over to tower frequency."

* * * *

"With our heavy type aircraft there was no way we could stay behind a small twin on the final. After we landed, we called the supervisor in approach control to ask why such tight spacing must be used. We pointed out that a 30 to 40 knot difference usually existed between a 4-engine jet and a 2-engine prop aircraft. The supervisor simply replied, 'We try to land as many as possible'."

Spacing intervals on the approach could be compressed vertically and horizontally when an airman followed the wrong aircraft to the runway.

"When I first saw him, he was approximately 30 feet horizontally and 20 feet vertically from the cockpit. After talking to the controller, it appears that the other pilot had picked up another aircraft and spaced himself on it...."

Forty-six percent of the overtakings (21 incidents) took place in TCA airspace. These numbers probably reflected the heavy pressures upon controllers in moving their traffic and also, the funneling effect of approaches into parallel runway layouts.

The TRSA and Non Stage III sequences included two additional elements: (1) training activities involving light aircraft - the "slow" unit in the equipment mix and (2) VFR aircraft that were flown into position in front of an air carrier on approach.

"When a single-engine aircraft first called the tower, he was 5 miles east, Negative Stage III. And he was right on the final approach course ahead of an air carrier jet.

"The air carrier saw the traffic just below them... it could have been a lot worse considering they were flying directly into the sun."

* * * *

"Student pilot was established by approach controller on a straight-in final for runway 13. He reported field in sight and was turned over to tower frequency. He then became confused, did not contact the tower.

"Repeated calls on the tower and approach frequencies were unanswered. Separation was lost. He finally called in on a 2 mile final to 09L, completely unaware of what had taken place behind him."

TRAFFIC MIX -- SIMULTANEOUS DEPARTURES AND ARRIVALS

A significant number of departure aircraft on climb-out conflicted with air carriers inbound on the visual approach. Thirty-seven such mixed operations were reported.

Three cause-and-effect patterns emerged from analysis of this set of incidents: (1) intrafacility traffic coordination deficiencies, (2) the proclivity of light plane pilots to depart VFR with early turn outs on to course immediately after takeoff, and (3) air carrier deviations from assigned altitudes.

With two aircraft on different frequencies and under control of separate controllers, timely and adequate coordinations are essential to ensure flight path separations. TRSA operations appeared more vulnerable than other categories of airspace to these climbing/descending conflict incidents. Thirteen of the 19 coordination failures took place at TRSA airports.

Controller explanations of the events were various: "I was too busy due to the mix of small aircraft, fighters and air carriers...." "A runway change was in progress...." One report noted "betting on the come", a jargon phrase that referred to a controller's anticipation that an aircraft would have an adequate margin of altitude or time separation in clearing the path of a second aircraft moving through the same airspace.

"Air traffic controllers often 'cheat' on the rules or on local procedures to expedite traffic. When we don't cheat it's called a slowdown.

"In this instance, I was concerned about getting air carrier ABC down as soon as possible. He was number one for

> the approach so I issued him a descent to 3000 feet. I was aware that local procedures do not permit this. However, with his type of equipment I considered it unlikely that he would descend early.
>
> "I did not see the target of departing aircraft BCD who was outbound.... ir carrier ABC questioned me as he passed over the top of the other aircraft...."

In 13 conflict incidents, the departure aircraft lifted off, turned and crisscrossed through the air carrier's descent path. All 13 departures were light plane, VFR operations and all but one event occurred in TRSA or Non Stage III terminal airspace. Five reports specifically noted an airman's "Negative Stage III" rejection of ATC services.

Runway layouts appeared to have pertinent links in the departure/arrival event chain. Departures from intersecting runways followed by low altitude turns figured in 12 conflicts. Single-runway operations generated head-on types of conflicts: 7 mid-air convergences were induced by either spacing misjudgments by tower controllers, by altitude deviations by the inbounds, or by failure of the VFR pilot to follow ATC instructions for a turn away from traffic.

COMMUNICATION MISUNDERSTANDINGS AND ERRORS

Two separate types of communication problems - each with its own human factor drives - were identified in the visual approach study. Overanticipation by airmen awaiting descent clearance introduced the "I heard what I expected to hear" syndrome while "We goofed" glitches in normal routine communication practices represented the universal traits of forgetfulness, mistakes, and mental slips in frequency selection.

Thirty-five altitude deviations were identified in the data set: approximately one-half of these unauthorized descents (17 incidents) could be attributed to flight crew misconstruals of ATC transmissions.

> Controller: "This will be visual to runway 27 right."
> First Officer: "Okay, a visual to the right."

This excerpt from an altitude deviation report exemplified the verbal trap for unwary airmen in visual approach terminology. "Expect a visual", "You will be cleared for a visual...", "this will be a visual...", "Upon sighting the field you will be cleared for a visual..." - all open-ended, garden path inducements for a less than diligent flight crew's reading of present tense - "you are cleared" - into "you will be..." future tense phraseology in the clearance message.

> "I saw traffic ahead and wondered why we had been cleared for the visual through his altitude. At that moment approach control called. 'Air Carrier ABC, I have you at 6200 feet, descending.' The first officer was obviously startled, looked at his altimeter and then at me. I said to him, 'We're on a visual', to which he replied, ' Plan a visual'..."

The psychological drive that induced such misinterpretations is a familiar cockpit characteristic: in VMC conditions, with the airport in sight ahead, the flight crew were "spring-loaded" to expect clearance to descend. The normal urge to pull back the thrust levers and ease into a 3-degree glidescope intensified in inverse proportion to the distance out from threshold. "We were so close in and so high that this may have influenced what we heard", read one airman's explanation. Another report: "If we had stayed up, landing would have been impossible."

The report set indicated that whenever the air/ground clearance dialogue was drawn out or extensive, airmen tended to assume that somewhere in the verbal exchange a clearance to depart from their last assigned altitude has been issued.

The second set of communication deficiencies generally consisted of "I goofed" admissions of error: "the five sounded like a nine", explained one pilot. "I transposed the first two numbers of the tower frequency", stated another. Several airmen reported their selection of the wrong tower frequency (7 incidents) because "approach control did not issue us the tower frequency". In 3 of these "wrong tower" frequency selections, the wrong tower responded to their call. In each instance, the flight crew "read" a landing clearance into the response to their aircraft call sign; "We thought

we heard a landing clearance...", "We heard what seemed to be a clearance...", and "In the background, we heard our call sign and assumed that...."

Twelve air carrier landings accomplished without tower clearances resulted from such human factor errors in communications. Since "good weather" conditions were requisite for the visual approach, the unauthorized landing incidents appeared to offer minimal potential hazard. Acceptance of the happenings as a somewhat venial type of ATC rule infraction appeared to be supported by the narratives: airmen noted that on many occasions the tower controllers has passed off their radio omissions with tolerant "no problem" responses to their embarrassed apologies during roll out.

Random human factors surfaced in this set of unauthorized landing incidents. The Joycian stream-of-consciousness narrative below depicts the story of a low work load, "everything looks great" type of visual approach.

> "The weather is beautiful so we talk approach control into a visual. No traffic. Unusual for this place. 'Cleared visual, contact tower at the outer marker.' Perfect. Copilot's leg. Monitor everything. Did we miss anything? No, looks good. Nice approach. Perfect touchdown. What's this?? We never changed over to tower frequency! No clearance to land!!"

WORKLOAD DISTRACTIONS

Workload distractions in air carrier cockpits were reported as causal agents for 14 deviations from assigned altitudes stemming from loss of altitude awareness and 18 landings made without tower authorizations.

The types of distractions were all too familiar terms in aviation: overattentiveness to traffic, particularly during approaches to parallel runways (9 reports). checklist overlaps (5 incidents), and a miscellany of operational tasks characterized generally in the narratives as "heavy workload" (4 reports). One such report "Our airline policy of 'keeping it clean as long as possible' so compressed our workload that we had no time to call the tower". The overlap of routine operational tasks was noted in 18

unauthorized landing incidents; one of the ultimate distractions to communications - a badly unstabilized approach - "wiped out" flight crew attentiveness to the required tower communications task in seven other landing incidents.

An identical listing of distraction - monitoring traffic, checklists, looking for the runway, conversation with a jump seat rider, etc., resulted in 14 altitude deviations.

HASTY MISJUDGEMENTS

While over-anticipation of descent clearances led some airmen into premature dips below their assigned altitudes, other airmen were caught by surprise by a sudden and unexpected ATC release for initiating the final approach into the runway. The trap was set by positioning the aircraft into a high, close-in location to the airport. The distance out varied in the narratives but the aircraft always were well above the normal miles versus altitude ratio for a desired 3 degree slope to the runway. "We were set up for the trap. We were 15 miles out at 280 knots and at 10,000 feet when ATC asked if we could get it down." etc., etc.

"If you can get it down, I'll clear you for the visual...", "If you can get down in time...", "If you can get down from there...", a dozen pilot reports quoted a controller's provocative invitation to his number one aircraft in the approach procession. The use of the personal pronoun "you" tended to personalize the question into a semi-challenge that carried echoes of the deeply rooted "I bet you can't - I bet I can" type of dare. The trap was sprung when the flight crew hastily responded "yes", summarily pulled back the thrust levers and headed down the chute toward the runway.

With the thrust levers at idle, in a steep, nose-down attitude, with a sink rate pegging out at instrument limits and, often as not, with the ground proximity warning system sounding its "Whoop-whoop! Pull up!" command, the resulting unstabilized approaches represented a drastic excursion from accepted airline techniques.

"We were badly unstabilized, our descent rate was over 5000 FPM...."

* * * *

"We ended up in a dangerous, very high rate of descent...."

* * * *

"All engines were in reverse, we were fast, at a high rate of descent...."

* * * *

"Approach Control asked if 'could we get it down in time'. I placed the engines in reverse, dropped the gear...about 2 miles out the tower said 'you are lined up with the wrong runway.'"

Probably every seasoned airline pilot has been induced, tempted, or trapped into attempted execution of such an approach. In this study, 25 airmen's reports of unstabilized approaches appeared to demonstrate the capabilities of the visual approach procedure for inducing flight crews into a high, fast, steep approach toward the runway.

Once initiated, the unstabilized descents carried into various types of hazardous occurrences. Seven approaches resulted in landings without tower clearance. "I became so preoccupied in salvaging the landing that I forgot to call the tower." "We were high and fast and got busy... we never realized that we had not changed over to tower frequency until we were rolling on the runway."

Five flight crewmen who "made it in" frequently reported with the rueful comment, "We should have gone around". Two air carriers hit so hard that the aircraft were damaged. Another overran the far end of the runway. Six traffic conflicts took place. There was one lineup to and one landing on the wrong runway. Go arounds (10 incidents) were the most frequently reported outcomes of the unstabilized finals.

Those airmen who reported their refusal to "dump everything" appeared to end up between "the rock and the hard place". Their unilateral efforts to

obtain maneuvering room for a normal rate of descent to the field - turning away from the airport, extending their downwinds or base legs, making 360 degree turns - resulted in 6 abrupt visual confrontations with other aircraft, merged targets on the radar scope and vehement controller displeasure.

> "We were cleared for the visual but we were much too high - at 3500 feet and only about 2 1/2 miles north of the runway. I told the First Officer to advise the controller that we were starting a 360 degree turn to lose altitude.
>
> "'Negative!' said the controller, 'You play by my rules!' I grabbed the mike and said, 'I'll play by your rule but we need room to get this thing down!'"

SUMMARY

The hazardous events reported by airmen and ATC controllers associated with conduct of the visual approach procedures did not develop from stressful or even difficult situations in flight. They did not evolve from bad weather conditions, low fuel quantities, engine shutdowns, malfunctions, turbulence, or other similar type circumstances. Rather, the majority of operational mishaps appeared to have been of the participants' own making and demonstrated the human factor traps and pitfalls in perfunctory accomplishment of a simple, routine procedure in a VMC, see-and-avoid environment.

Human factors were prevalent throughout the document set: "We are lax in our handling of visual approaches at this facility." "We did not bother to cross-check our navigational instruments." "Don't worry! He's VFR!" "We heard our call sign and assumed...." The error patterns and event sequences were varied but the human factors remained constant: throughout the study the airman and controller reports suggested a broad, repetitive pattern of complacency, a behavioral trait that appeared all too frequently in unwarranted assumptions, in relaxed, unguarded attitudes and in a sense of false security that "everything would work out okay".

In incident after incident, the analysis of hazardous events indicated that the participants in the visual approach procedure has not paid the full

price for the convenience and freedom to operate outside the rigid framework of full-IFR operations. This determination suggested a general call for exact, precise and complete adherence to the fixed procedural steps outlined in AIM and in the Controller Handbook for ATC issuance and airman acceptance of the visual approach.

The general recommendation could be specifically referenced to various types of hazardous occurrences listed in the study:

- Cockpit traffic sighting responsibilities to be emphasized in air carrier training programs.
- Air carrier airmen to be aware of the double jeopardy in failure to report loss of sighting of traffic to ATC: (1) Potential risk of collision with the unsighted aircraft and (2) Reluctance of radar controllers to intervene in a closing target situation due to the previous report that traffic had been sighted.
- Descriptive terms in target callouts such as "company traffic", "small twin", etc., to include o'clock directions and distance estimates.
- Pre-clearance transmissions subject to cockpit misinterpretations to be minimized: "This will be a visual...", "Plan a visual...", "If you can get it down you will be cleared for a visual...", "Continue visual to the field...", "Upon sighting the airport you will be cleared for a visual...", etc.
- The operational meaning of the "airport in sight" response as "runway in sight" to be clarified.
- ATC altitude restrictions maintained until the aircraft is in a high, close-in position to the runway to be recognized as incompatible with the visual approach procedure.
- Controller pressure upon airmen - described as a "push into the visual" - to be more widely understood and accepted by the airmen as the consequence of heavy inbound traffic.
- A controller's words summarize this suggestion; "Our Stage III program is not as effective as it should be. The instructors at the flying schools located at this airport teach their students to say 'Negative Stage III' instead of instructing them how to use the system.

- Airmen, during conduct of visual approaches, to be aware of serious hazard potentials:
  1. With uncontrolled VFR aircraft operating in TRSA or Non Stage III airspace.
  2. During parallel runway operations - due to overshoots into or lineups in the wrong approach lane and/or with crisscrossing flight path patterns into adjacent runways.
  3. During environmental conditions such as glare, haze, position of a rising or setting sun, etc.
  4. In the operational mix of slow/fast, prop/jet equipment in congested terminal airspace.
  5. In cockpit procedures for crosschecking navigational instruments for the correct runway, and in unfamiliar circumstances, for the correct airport.

In overview, a fundamental irony appears to permeate the entire set of hazardous occurrences associated with the visual approach procedure. For decades, the major resources of the ATC system have been dedicated to full-time protection of passenger air transport operations. From the first push-back off the gate, air carrier airmen are vectored, advised, instructed, and monitored through climb, cruise, and descent phases of their passage through enroute and terminal airspace.

However, when the destination airport is announced as "in sight" and the pilot accepts the visual approach, then the protective shielding is withdrawn and the air carrier jet airman proceeds to the landing runway in a see-and-avoid environment.

The visual approach procedure is cost-effective, time expedient, and essential. Yet the irony persists. The controller words below appear to summarize the contradiction inherent in the visual approach procedure:

> "At this airport, once we clear an aircraft for a visual approach we rely upon the pilot to miss all traffic that is a factor for him. At times, our reliance upon one flight crew to prevent a midair collision has jeopardized the passengers and crew of another aircraft."